

POTENTIAL GRADUATE STUDENT RESEARCH PROJECTS



Version 7-S

For Student Distribution

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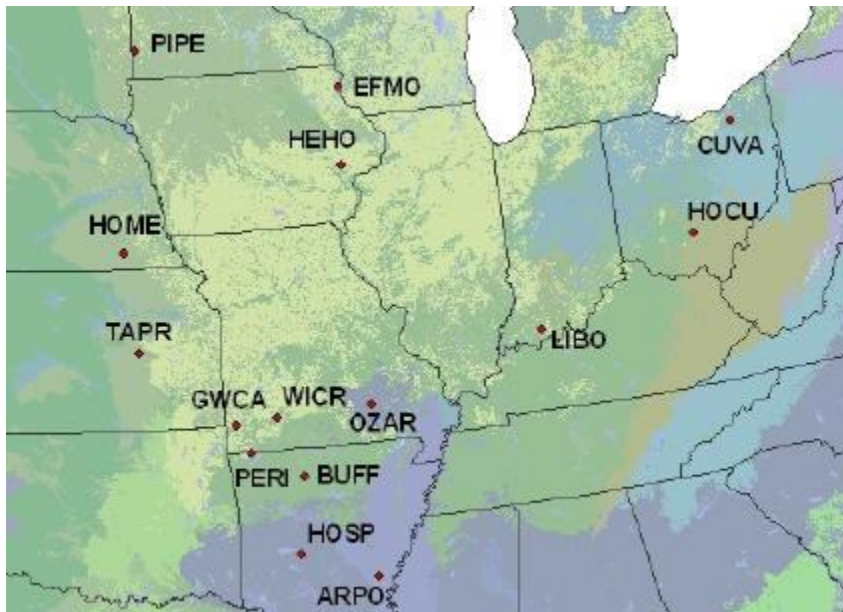
BACKGROUND

The National Park Service serves as a steward for the preservation of America's national parks and their resources. The NPS has initiated a service-wide, network-based natural resource inventory and monitoring program to design and implement long-term ecological monitoring, and provide information for park managers to evaluate the integrity of park ecosystems and better understand ecosystem processes.

The Heartland Inventory and Monitoring Network is one of 32 NPS I&M networks assisting 270 parks with biological inventories and long-term vital signs monitoring. “Vital signs” are a subset of physical, chemical, and biological elements and processes of park ecosystems that are the most significant indicators of ecological condition for those specific resources that are of greatest concern to each park. The Heartland Network is composed of fifteen parks in eight Midwestern states representing tallgrass prairie, Ozark highlands, and eastern deciduous forest eco-regions.

This monitoring program has created a number of opportunities for collaborative research and educational activities with Missouri State University. This document contains summaries of potential graduate student research projects that would both complement the activities of the Heartland Network and provide a meaningful context for scientific research.

PARKS



Abbreviations:

Inventory and Monitoring (I&M)

- Arkansas Post National Monument (ARPO)
- Buffalo National River (BUFF)
- Cuyahoga Valley National Park (CUVA)
- Effigy Mounds National Monument (EFMO)
- George Washington Carver National Monument (GWCA)
- Herbert Hoover National Historic Site (HEHO)
- Homestead National Monument of America (HOME)
- Hopewell Culture National Historic Park (HOCU)
- Hot Springs National Park (HOSP)
- Lincoln Boyhood National Monument (LIBO)
- Ozark National Scenic Riverways (OZAR)
- Pea Ridge National Military Park (PERI)
- Pipestone National Monument (PIPE)
- Tallgrass Prairie National Preserve (TAPR)
- Wilson's Creek National Battlefield (WICR)

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TERRESTRIAL PROJECTS

Effects of habitat manipulation on Missouri Bladderpods

Park: WICR

Summary: The Missouri Bladderpod is a federally threatened plant species that exists in several glades at WICR. Observational monitoring data obtained by the I&M program indicates a number of potentially important correlations between bladderpod presence or abundance and various habitat variables. The only way to determine whether a cause and effect relationship exists, however, is to conduct properly controlled and randomized field experiments. A number of habitat variables are thought to be important and could be manipulated (e.g., removal of Eastern red cedars [*Juniperus virginiana*], controlled burning, removal of non-native plants).

Expected outcomes: This manipulation would test hypotheses generated by I&M monitoring data, provide useful information to park managers, and be of general value in the effort to preserve this rare species.

Contact: Young

Comparing root biomass in grazed versus ungrazed tallgrass prairie**Park:** TAPR

Summary: The literature suggests that perennial tallgrass prairie grass species respond to above ground defoliation by utilizing root resources to generate new blades and flowering culms. Under intense, repeated defoliation, root resources may be depleted resulting in death of the plant. Observations in ungrazed tallgrass prairie describe vigorous, above-ground growth following fire (e.g., flowering culms in excess of 6 feet). In 2005, windmill pasture was burned as usual in the spring but rested from grazing for the first time in several years. Vegetation profile data show greater above ground biomass following fire in the absence of grazing; however, the response was much less than observed in adjacent areas that are not regularly grazed. This suggests that root reserves are becoming depleted in the historically grazed portions of the preserve.

Expected outcomes: A comparison of root biomass in ungrazed and historically grazed areas in the preserve may elucidate the long-term effect of annual fire and grazing on the growth and vigor of tallgrass prairie grass species. This information is likely to be very useful to park management.

Contact: DeBacker

Impacts of white-tailed deer on vegetation

Park: WICR, PERI (possibly others)

Summary: National Park Service lands within the Heartland Network are inhabited by populations of white-tailed deer (*Odocoileus virginianus*). Due to elimination of natural predators and human alteration of the environment, white-tailed deer often reach high densities. To investigate the potential impact of white-tailed deer herbivory on understory vegetation and tree regeneration, deer-proof exclosures along with paired control plots could be employed. A one-year vegetative impact study was conducted at PERI in 2003 (Grabner et al.), and the 40+ exclosures (including treatments and controls) used in that study are available for use. These exclosures are reportedly in good repair, and a multi-year data record may be available for anyone willing to identify and quantify the plants present in the exclosures.

Expected outcomes: Results of this project(s) would provide resource managers with information critical for protecting and enhancing native vegetation. Such surveys would increase our overall knowledge of the impacts of white-tailed deer browsing on vegetation.

Contact: Peitz

Literature Cited: Grabner, K. W., M. Struckhoff, and D. Buhl. Evaluating the impacts of white-tailed deer (*Odocoileus virginianus* [sic]) on vegetation within Pea Ridge National Military Park. USGS report.

Assessing the accuracy of road-based spotlight surveys for white-tailed deer

Park: WICR, PERI (possibly others)

Summary: White-tailed deer (*Odocoileus virginianus*) often reach high densities due to elimination of their natural predators and human alteration of the environment. High deer abundances may negatively impact native vegetation and cause vehicle accidents. Roadside spotlight deer surveys are conducted in several network parks to estimate trends in deer numbers. Roadside spotlight surveys cannot be used to estimate absolute densities as can other methods, such as mark-resight techniques, although they are much less expensive and time consuming. The distance sampling method could be applied to road-based surveys, if it could be determined that no road bias effect exists. To determine the correlation between spotlight survey results and absolute deer densities, or whether a road bias effect exists, alternative methods (such as pellet group counts or use of infrared cameras) could be employed and the results compared to our spotlight data. Spotlight surveys have been initiated in several parks and this data could be made available to the student.

Expected outcomes: Results of this project will provide Heartland Network staff and resource managers with information critical for estimating white-tailed deer densities within a park, and could be useful for other agencies involved with monitoring white-tailed deer populations. Such surveys would also increase our general knowledge of deer density estimating methods.

Contact: Peitz

Changes in population densities of small mammals**Park:** PERI

Summary: In 1971, a study of small mammal densities was conducted at Pea Ridge National Military Park (Johnsey & Malinen 1971). Live catch traps were used to capture small mammals, and estimates of population densities were determined for various habitat types. It would be possible to repeat the methods of this study and determine current population densities of small mammals in these same areas of the park. This would allow for documentation of changes in small mammal densities over this 35-year interval, in general and as a function of different habitats. The effects of habitat changes (natural and management-induced) on small mammal populations could be evaluated.

Expected outcomes: Because this baseline data set exists, this project represents an excellent opportunity to look at long-term change in small mammal populations. The findings would be valuable to resource managers attempting to restore or preserve natural habitats.

Contact: Peitz

Literature Cited: Johnsey, P. G., and M. O. Malinen. 1971. Final report on population densities of small mammals in relation to specific habitat in Pea Ridge National Military Park, Benton County, Arkansas.

Effects of cedar thinning on Sericea invasion**Park:** PERI (WICR)

Summary: *Sericea lespedeza* is an invasive plant that thrives in open sunny habitats. In some parks it is desirable to thin Eastern red cedars (*Juniperus virginiana*), as historical records indicate these cedars were not as abundant during the time period critical to the historical legacy of the park (i.e., the civil war). Clear cutting cedar produces open habitat in which *Sericea* quickly invades and becomes very abundant. *Sericea* does not grow in the understory of mature trees, however. Thus it is desirable to determine how much cedar thinning could be accomplished without creating conditions that will promote *Sericea* invasion. Plots could be established at PERI in which varying amounts of cedar thinning could be done, and the *Sericea* density quantified and compared. PERI may be able to provide the manpower to delimit the plots and conduct the removal of cedars. Potentially large plots, and enough replicate plots, should be available.

Expected outcomes: The results of this project would greatly aid managers in attempting to remove cedar without increasing the spread of this invasive plant. This project has important implications for forest restoration in general.

Contact: Young/James

Effects of prairie restoration**Park:** PERI

Summary: Pea Ridge National Military Park contains over 500 acres of grasslands. Over the next 2 years, 160 acres are scheduled to be converted into native prairies, with additional acreages converted in the future. This change in the species diversity of grasses and forbs will likely result in cascading changes throughout the overall grassland ecosystem. Thus, opportunities exist to study impacts on insects, small mammals, birds, or other groups. The effects on abiotic variables, such as nutrient cycling, could also be examined. Because such conversions will require several years, the trajectory of such changes over time could be evaluated. Since not all grasslands will be converted at once, representative control sites should be available.

Expected outcomes: The results of this project would enlighten resource managers to the broader implications of prairie restoration efforts. It would increase our knowledge of the overall impacts of changes in grassland community structure and function.

Contact: Young, James

Long-term changes in vegetative structure

Park: PERI (others)

Summary: In the late 1830's and early 1840's, the Government Land Office conducted surveys on a grid system at PERI, making observations at certain points, such as the tree species present and size of the tree, in addition to other information. It might be possible, using GPS technology, to return to many of these same points and document the changes that have occurred over the past century and a half.

Expected outcomes: The results of this project would provide resource managers with important information on long-term changes in vegetation. Such information may be particularly valuable in attempts to restore the natural habitat of parks commemorating the civil war to the vegetative structure present during that era.

Contact: Young, James

Land use and land management of ‘buffer zones’ near parks

Park: PERI (others)

Summary: The city of Pea Ridge is encroaching upon Pea Ridge National Military Park. Several large housing developments are planned, in addition to a city park that would adjoin the National Park. Roads and trails from this development could potentially be joined to park roads and trails. The issue is how this could best be done to both preserve Pea Ridge National Military Park and surrounding areas, and allow for the development and growth of the city of Pea Ridge.

Expected outcomes: Such a study may prevent harm to the natural and cultural resources of Pea Ridge National Military Park and the surrounding area, and serve as a model for other park units facing similar suburban encroachment.

Contact: Rowell

Evaluation of long-term change in small mammal communities**Park:** GWCA

Summary: In the 1980s, a number of small mammal surveys were conducted in different management units of GWCA by students at Missouri Southern State University. Although a number of different students took part in these projects, most (all?) had the same faculty advisor (Dr. James Jackson), and used similar or identical methods. It should be possible for a student to summarize the data from these surveys, and conduct additional surveys using the same methods to evaluate changes in small mammal communities over two decades.

Expected outcomes: The previous surveys contain data on population densities, species compositions, and home ranges, and would allow evaluation of changes in these parameters over time, and correlations with prairie management.

Contact: Peitz

Literature: Reports from these studies were published in the *George Washington Carver National Monument Research Bulletin*. This publication contains studies on a diversity of taxa, and organisms other than small mammals could also be the subject of such studies.

Bird species composition and change**Park:** GWCA

Summary: From 1992 through 1997, biologist Barry Jones recorded bird sightings at GWCA on an almost daily basis. Qualitative annual summaries were also compiled, but the data were not subjected to a rigorous quantitative analysis. It should be possible to look at potential change in the bird species composition at GWCA on a yearly basis from 1992 to 1997 from this data, and by conducting additional surveys, evaluate change over a longer period.

Expected outcomes: This work may indicate to managers important trends in bird populations at the park, and provide an updated species list. Many park visitors are birdwatchers and are interested in the bird fauna.

Contact: Peitz

Effect of precipitation and disturbance on Western Prairie Fringed Orchids**Park:** PIPE

Summary: The Western Prairie Fringed Orchid (*Platanthera praeclara*) is threatened throughout its existing range and annual population estimates sometimes vary greatly. Because orchids have close associations with soil fungi, precipitation at critical points in the plant's annual life cycle may hold the key to understanding flower and fruit production. Local disturbance such as fire may also play a role because it can temporally affect soil moisture, nutrient cycling, and light at the ground level. A factorial, garden type experiment is warranted to test an existing model and increase understanding of the habitat needs of this plant. Potential variables include: ambient precipitation, above normal precipitation (watering), below normal precipitation (rain out shelters), and, if possible, a burning treatment. The timing of precipitation may also be incorporated into treatments if enough resources are available. It is likely that a combination of the treatments will yield improved understanding of this plant's habitat needs. In conjunction with the experiment, natural history information could be collected to further understanding of this species.

Expected outcomes: This study would test a current model which draws on HTLN monitoring data. The monitoring data could also be used to put the results of the study in context and then to test its conclusions *in situ*. This critical information is needed for managers to provide conditions conducive for reproduction in the Western Prairie Fringed Orchid.

Contact: Leis/Young

Effects of prescribed fire on land snails**Park:** EFMO

Summary: Land snails, potentially including the endangered Iowa Pleistocene Land Snail, *Discus macclintocki*, occur in the woodlands of Effigy Mounds National Monument. Little is known about the biology of these snails or how individuals and populations respond to prescribed fire. Although the I&M program has data relating to the plant community, and the park has recent fire history information, no studies have been done at the park to investigate how these snails respond to ecological disturbances. The park is divided into burn units that are treated on a rotational basis, and a study of the effects of fire on land snails could be conducted.

Expected outcomes: The results of such a study may allow resource managers to plan burns in a way that would reduce deleterious effects on land snails.

Contact: Leis

Restoration progress in a 37 year old prairie restoration**Park:** HEHO

Summary: Herbert Hoover National Monument planted a prairie restoration in 1971, and the plant community has been monitored for 25 of the past 37 years. The prairie is approximately 80 acres and lies in an urban landscape, and may be an important refuge for grassland wildlife such as insects and birds. The park is interested in understanding how best to apply fire to support insect populations. Full restoration of a grassland community is dependent upon changes in the soil such as nutrient cycling, carbon storage, filtration, etc., and many insects rely on underground resources to complete their life cycle. An analysis of the soil chemistry, especially soil carbon and nitrogen, would inform managers as to the maturity of the prairie restoration. A research question might be: Do the soil and nutrient dynamics more closely resemble a native prairie or an agricultural system? Together, an insect survey and soil analysis will help managers assess past restoration efforts and plan for the future of the prairie. Plant and bird data are available from long-term monitoring, and these could supplement sampling efforts for this project.

Expected outcomes: Together an insect survey and soil analysis will help managers plan for the future of the prairie and evaluate the successfulness of the restoration and augmentation efforts.

Contact: Leis

Ranch management history at the Tallgrass Prairie National Preserve in Kansas**Park:** TAPR

Summary: The Flint Hills of Kansas has a diverse ranching history. Management techniques, including grazing, burning, brush hogging, and herbicide use, have been employed to varying degrees at different periods. Proper interpretation of monitoring data often hinges on disturbance history. In tallgrass prairie habitat, the response to long-term disturbances such as grazing or burning can exacerbate or complement shorter term responses to management. As land managers adjust current management practices, the effects on the plant and soil communities can sometimes be masked by past management. Tallgrass Prairie National Preserve in Kansas has an extensive history of ranch ownership. An understanding of the historic ranch practices, however, is lacking. The park possesses historical ranch records that can elucidate the management history of the land and improve understanding of current ranch practices.

Expected outcomes:

A final product would include a compilation of detailed ranch practices for each recorded ownership era at the park. The report should include any information of the grazing system, stocking rate, burning practices, herbicide practices (and extent), and other relevant details. Since the park has not always been under a single ownership, a spatial representation of the park and some of the management practices could prove valuable. Many options exist for placing the detailed ranching history within a broader context. For example, a further analysis could compare the ranching practices to other areas inside or outside the Flint Hills of Kansas, or speculate on the impact of current management with respect to past disturbance history.

Contact: Leis

Historical fire return interval or vegetation composition analysis**Park:** WICR**Summary:**

Wilson's Creek National Battlefield has a rich cultural history. Archaeological surveys have been conducted systematically as well as opportunistically to learn more about the people and events that characterized this area. One piece of the puzzle that is currently missing, however, is empirical data on the occurrence of fire and plant composition at the park prior to federal acquisition. Because Wilson's Creek is situated on the ecotone between the Great Plains and the Ozarks, it is uncertain which model of disturbance history would provide the most accurate representation of the past. Currently, we infer fire return intervals through time from surveys done elsewhere in the Ozarks and surrounding Great Plains (Anderson 2006, Axelrod 1985, Guyette *et.al.* 2002, Dey *et.al.* 2004). Surveys measuring the occurrence of fire from charcoal or tree rings, as well as inferences of historical vegetation from pollen or seed type analyses, would help managers to define realistic desired conditions for the park. This data would be used as a reference point for comparison of current conditions and changes through time as well as the planning of realistic fire return intervals.

Expected outcomes:

An analysis of fire return interval or changes in vegetation composition through time would help fill in some important information gaps. The data could be used to help visitors understand the history of the park as well as to give natural resource and monitoring staff an empirical reference point for comparison of current and desired conditions.

Contact: Leis**Literature cited:**

- Anderson, R. C. 2006. Evolution and origin of the Central Grassland of North America: climate, fire, and mammalian grazers. *Journal of the Torrey Botanical Society* **133**:626-647.
- Axelrod, D. I. 1985. Rise of the grassland biome, Central North America. *The Botanical Review* **51**:163-201.
- Guyette, R. P., Muzika, R. M., and D. C. Dey. 2002. Dynamics of an anthropogenic fire regime. *Ecosystems* **5**:472-486.
- Dey, D. C., Guyette, R. P. and M. C. Stambaugh. 2004. Fire history of a forest, savanna, and fen mosaic at White Ranch State Forest. *Proceedings of the Upland Oak Ecology Symposium Gen. Tech. Rep. SRS-73*. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station 132-137.

Which instrument is more reliable: A traditional psychrometer or hand held Kestrel®?

Park: All parks that use prescribed fire as a management technique

Summary: Fire monitors—whether working on prescribed fires (a.k.a. controlled burns) or wildfires—rely on psychrometers in the field to measure temperature in both dry and wet bulbs. The resulting data is used to calculate relative humidity (RH) and dew point. RH is a critically important component of fire prescriptions and fire behavior is predicted in part by this element. Low RH values signal a drop in fuel moisture of 1-hr fuels (light fuels) that carry the fire. As RH and fuel moistures drop, an increase in fire behavior may also occur. While psychrometers are the standard for measuring weather in the field, they have sources for error. Many versions of the psychrometer are easily damaged by breaking the thermometers or by using dirty water to wet the wick on the wet bulb thermometer. Moreover, once temperatures are obtained, tables must be used for the calculation. As a result, there are several sources of operator error.

More recently, Kestrel® developed a hand held digital weather meter. There are several models that have increasing functionality. The meter's ability to accurately reflect the weather has improved and some firefighters now use it exclusively. Most firefighters, however, report differences between the two instruments—RH readings in particular—and relegate the Kestrel® for wind speed measurements only. A recent anecdotal study contended that the Kestrel® might actually be more accurate, especially within certain temperature ranges. Furthermore, there are few opportunities for observer error in its use.

A study to compare data collected by the traditional psychrometer to the Kestrel® and perhaps a NOAA instrument in a variety of weather conditions would be invaluable to informing practitioners in the field. The study should include replicates of both instruments in a variety of weather and field conditions. Brand new instruments should be used according to specifications.

Expected outcomes: Weather is a critical component of prescribed fire. Inaccurate weather readings may lead to a burn being canceled for being out of prescription or a fire being conducted under less than ideal conditions. The use of an accurate and reliable instrument for collecting weather data is critical in both wildfire and prescribed fire situations for meeting natural resource and safety objectives. A study of this sort would have wide reaching implications for the field.

Contact: Leis

Interaction of the Missouri Bladderpod (Lesquerella filiformis) with an exotic annual brome grass (Bromus japonicus)

Park: WICR

Summary: The Missouri bladderpod is a federally threatened plant. It is found in Ozark glades, a habitat type that is shrinking. Fire is often used to maintain and restore glades, but burning at a time most appropriate for the bladderpod may cause an increase in exotic annual brome grasses. Some research suggests a competitive relationship between annual exotic brome grass and the Missouri bladderpod (Thomas and Jackson, unpublished data). Both species are annuals that flower and fruit in the spring. Understanding the phenological relationship between the two plants may help to identify appropriate control measures. Furthermore, more investigation needs to be done to understand whether the presence of brome is detrimental to Missouri bladderpod. Natural history studies and greenhouse experiments may be useful in determining the relationship of flowering periods and the nature of competition between the plants. The outcome of the above investigation would determine if tests on herbicide (such as imazapic-based herbicides) resilience of Missouri bladderpod are appropriate.

Expected outcomes: Results of this project(s) would provide resource managers with information critical for protecting and enhancing Missouri bladderpod communities. Prescribed fire is essential for maintaining glades, but burns must be restricted to late summer to avoid negative effects on the Missouri bladderpod. Burning at this time seems to enhance annual brome grasses, however. Understanding whether annual bromes negatively affect bladderpod is essential to long-term management strategies. If a negative relationship is found, appropriate control measures for annual brome grasses will also be needed.

Contact: Young, Leis

AQUATIC PROJECTS

Biodiversity of macroinvertebrates in spring ecosystems

Park: BUFF, OZAR--small springs

Summary: Preserving water quality requires an understanding of water sources. This is important to both the Buffalo and Current Rivers, given their karst geology and the fact that most of their water comes from springs during base-flow conditions. Macroinvertebrates are important indicators in determining the health of a spring due to their varying tolerances to pollutants and sedimentation. The I&M program has initiated long-term monitoring of six large springs at OZAR. A number of smaller springs at OZAR and springs at BUFF (which in general are smaller than those at OZAR) are currently not being studied. The macroinvertebrate community at these smaller springs could be quantitatively sampled in a similar manner as the large springs at OZAR are currently monitored.

Expected outcomes: This project would provide baseline data on the smaller springs for potential long term monitoring and early warning indicators to park management. At BUFF, spring locations have been mapped, and baseline water quality data collected for some. A spring inventory is underway at OZAR. Comparisons could be made with the large springs at OZAR that are monitored on an annual basis.

Contact: Bowles

Influences of macroinvertebrates on nutrient cycling

Park: BUFF: specifically (upper) Mill Creek

Summary: Mill Creek in the upper section of the Buffalo River has historically had high nutrient levels due to non-point source inputs from agriculture in the recharge area of Dogpatch Spring. In 2005, a macroinvertebrate assessment was conducted on 20 BUFF tributary water quality stations, and Mill Creek was found to have the highest number of individuals of any site (11% of the overall total of individuals collected). The high nutrients levels coupled with stable habitat is believed to be the reason for increased abundance. A study is needed of the relationship between these increased abundances and nutrient cycling in Mill Creek, and the potential impacts on other biota within the system.

Expected outcomes: This study would provide invaluable data to park management on potential impacts of high nutrients on the biota of Mill Creek and the Buffalo River, and help elucidate the effects of nutrient loading in general.

Contact: Bowles

Effects of sedimentation on macroinvertebrate communities in relation to bank erosion**Park:** BUFF

Summary: A study of Bear Creek, a major tributary of the Buffalo River, revealed concerns regarding high sedimentation causing a decrease in diversity of macroinvertebrates (*2005 Characterization of Macroinvertebrate Community and Drift in a Tributary of Buffalo National River, Prior to Damming*). Chronically eroding streambanks and resultant channel instability on the Buffalo River frequently leaves stretches of bank completely denuded of riparian vegetation, compromising in-stream habitats and degrading water quality. A study of the effects of this sedimentation on macroinvertebrate communities is warranted due to increased bank erosion. A separate (or comparative) study could be conducted in conjunction with the bank restoration efforts currently underway at BUFF (*2005 Programmatic Environmental Assessment of Streambank Management Plan for the Buffalo River*).

Expected outcomes: This project would provide vital data in determining the impact of bank erosion, and elucidate effects of bank restoration on macroinvertebrate community health. This information would be important to park managers at BUFF and of general interest to stream ecologists.

Contact: Bowles

Effects of mussel beds on nutrient spiraling

Park: BUFF, specifically (upper) Mill Creek

Summary: Mill Creek in the upper section of the Buffalo River has historically had high nutrient levels due to non-point source inputs from agriculture in the recharge area of Dogpatch Spring. In 2005, an assessment and habitat evaluation of native freshwater mussel resources of the Buffalo National River was conducted and a large bed was located just downstream of the confluence of Mill Creek. The high nutrient levels coupled with stable habitat is believed to be the reason for its existence. A study of the relationship between this bed and nutrient cycling in Mill Creek is needed.

Expected outcomes: This project would provide invaluable data to park management on potential impacts of high nutrients on the mussel beds of Mill Creek and the Buffalo River. The study could have broader implications for pollutants in relation to mussel beds, and appeal to stream ecologists in general.

Contact: Bowles

Evaluation of the effects of fecal coliform pollution on invertebrate and fish communities

Park: OZAR, specifically Jacks Fork and Shawnee Creek

Summary: Microbial contamination, primarily fecal coliform bacteria and *E. coli*, in the Jacks Fork River, OZAR are well documented and portions of this stream have accordingly been placed on the US EPA 303(d)-list. Shawnee Creek, a tributary of the Jacks Fork has also had documented high levels of microbial contamination, associated with horses during trail rides in the park. Because of high levels of microbial contamination in this tributary, park staff have previously restricted public access. Although the negative human health impacts of such microbial contamination are well-documented, impacts on the fish and invertebrate communities have not been studied. This represents an opportunity to document the condition of the aquatic communities in those portions of Shawnee Creek where high bacteria loading occurs.

Expected outcomes: High fecal coliform levels represent a well known and documented human health hazard, but less information is available on the impacts of such pollution on aquatic communities, or its long-term consequences. This proposed project would be a step toward answering those questions. Some funding may be available through OZAR for this project.

Contact: Bowles/Dodd

Dragonfly and damselfly (Odonata) inventories

Park: ARPO, others

Summary: Dragonflies and damselflies are common invertebrates associated with aquatic habitats, although species compositions are not well known at ARPO or many other parks. One could collect larval and adult Odonates from aquatic habitats using a variety of collection methods. Species occurrence lists could be prepared by habitat type, and habitat types could be described where known. Similarity indices could be applied to the data where appropriate. Many larval Odonates remain unassociated with their respective adult forms. There is substantial opportunity to make such associations with a project of this type.

Expected outcomes: This project represents a significant step in inventorying the invertebrate fauna of this and other parks. Odonates are popular with the general public and this project would be an excellent way of communicating science to visitors in terms they may better appreciate. Many Odonatologists are amateurs or hobbyists, and this project could be conducted at low cost to the park or network.

Contact: Bowles

Comparison of fish or aquatic invertebrates in lentic and lotic habitats**Park:** OZAR, BUFF

Summary: ‘Backwater’ habitats are those connected to the main river, but with no or little flow. These lentic extensions of the main stem have a different temperature regime, and contain different species of fish, invertebrates, and aquatic plants compared to the lotic main stem. Sampling these backwaters for fish could be accomplished by the same or similar techniques as currently applied to I&M monitoring efforts on the main stem. Sampling invertebrates would require a different methodology, but appropriate standardized techniques are available.

Expected outcomes: The results of this project would allow for interesting comparisons to be made for the fish or invertebrate communities inhabiting these connected, yet physically different habitats. Such surveys would provide more information on park-wide species richness and species diversity than will be obtained by baseline I&M methods.

Contact: Bowles/Dodd

Electrofishing efficiency on Ozark rivers: Effects of temperature, discharge, and electrofishing gear on fish community samples

Park: BUFF, OZAR.

Summary: High sampling efficiency (i.e., collecting samples that are representative of the community) is a primary objective for any monitoring project. Most stream fish assessments in the Midwest take place in late summer to early fall due to stable flows and greater stability in fish community composition (i.e., low occurrence of spawning migrations). However, few studies have documented the most favorable time for fish assessments in the Ozark region. Environmental factors such as temperature and discharge affect fish community composition by causing either voluntary (i.e., spawning migration) or involuntary (i.e., swept downstream) fish movement. As a stream or river flows from headwaters to mouth, size of the lotic system increases. A combination of discharge (which fluctuates based on time of year) and location within the watershed dictates which gear type is more effective at collecting representative fish community data. The question of gear is particularly important in reaches where one gear type may be more effective at low summer flows, but another may be more effective during higher discharges in the spring. To evaluate the most efficient sampling techniques in various size streams or river reaches, sampling could be conducted several different times of the year with combinations of high/low temperatures, high/low discharges, and with various electrofishing gear. Fish sampling protocols from the I&M program could be used to collect data.

Expected outcomes: This data will not only aid the I&M program in determining the best time/conditions to sample and efficiency of different electrofishing gear in various reaches, but can be used by other state and federal agencies to decide when to monitor Ozark river systems.

Contact: Dodd

Recolonization rate of invertebrates along a losing reach**Park:** BUFF

Summary: A ~4 mile section of the Buffalo River goes dry in the middle of most summers, as water moves underground from a sink at Robertson Hole to emerge again at White's Spring. The invertebrates along this losing reach could be sampled before and immediately after the water returns, and then throughout the year to determine recolonization rates. Intensive quantitative sampling methods could be used to determine the diversity and density of arthropods. These measures obtained along the losing reach could be compared to upstream and downstream sections of the river that do not go seasonally dry.

Expected outcomes: This study has important implications for understanding the dynamics of losing reaches, the phenology of such streams, and the diversity and abundance of aquatic communities in general.

Contact: Bowles

Periphyton community composition as an indicator of change**Park:** BUFF, OZAR

Summary: Periphyton, or attached algae, is the principle algal component of the rivers at BUFF and OZAR. It is important to understand these communities because they are the primary energy producers for these aquatic systems, and are at the base of aquatic food webs, providing the main source of food for numerous fish and invertebrates. Algae community composition can be an indicator of water quality, and respond to a variety of environmental factors. There has been limited assessment of the algae communities at BUFF and OZAR. A study as part of a regional assessment by the USGS NAWQA program did find correlations between the biomass of blue green algae and agricultural land use, as well as the biomass of diatoms and substrate embeddedness, phosphate levels, alkalinity, and dissolved organic carbon levels.

Expected outcomes: The results of this project would supplement the missing trophic link in the fish and invertebrate data currently being collected. It would provide more information regarding species diversity in the parks as well as provide insight into another potential monitoring tool for the I&M program.

Contact: Bowles

Multiple habitat assessment of invertebrate communities**Park:** BUFF, OZAR

Summary: Invertebrate monitoring for BUFF and OZAR by the I&M program currently involves single habitat, semi-quantitative sampling within riffles. While this is a practical approach for calculating metrics and for long term monitoring, information regarding species diversity and habitat use is missing. There are previously defined hydrologic habitat units that combine physical and ecological characteristics that could each be sampled qualitatively based on the proportion within each reach, and organisms could be identified to species level when possible. This effort would produce a species list for each site, allowing species that are not sampled using traditional benthic sampling methods to be tracked, and increase the possibility of finding rare or threatened species.

Expected outcomes: This would supplement ongoing I&M invertebrate monitoring efforts. There is a protocol in development for multiple habitat sampling but it will not likely be implemented as part of the I&M program due to lack of time and staff. The state of Missouri also uses multiple habitat sampling as part of its biomonitoring program. Along with species diversity and habitat correlations, this information would provide insight into the usefulness and feasibility of adding multi-habitat sampling to the ongoing invertebrate monitoring at BUFF and OZAR.

Contact: Bowles

Sampling efficiency in prairie streams

Park: PIPE, possibly TAPR

Summary: When designing a monitoring project, gear selection and efficiency should be given careful consideration; testing of selected methodologies can provide important feedback. Seining is often used to sample fish communities in soft bottomed prairie streams. The Heartland I & M Network monitors fish assemblages in parks located within the tallgrass prairie region using minnow (common sense) seines. Some streams within these parks, however, contain cobble and boulder substrate. One such stream is Pipestone Creek located at PIPE. At this park, sampling methodology could be evaluated for relative efficiencies and biases due to different size channel units and larger substrates. Comparison of the seining method with other wadeable stream methods (e.g., backpack electrofishing) may clarify potential biases and sources of error when estimating fish community metrics. One study (Dauble and Gray 1980) found that backpack electrofishing gear was more effective in nearshore areas of rivers that had irregular substrate and faster flows, while seines were better in more uniform substrate (such as that found in typical prairie streams). This project could be extended to fish communities at TAPR, which also include streams with larger substrates.

Expected outcomes: This project will assist the I&M program in determining the efficiency of seining versus electrofishing in prairie streams with diverse substrates, and results could potentially be used by other state and federal agencies to determine appropriate gear selection.

Contact: Dodd

Literature cited:

Dauble D.D. and R. H. Gray. 1980. Comparison of a small seine and a backpack electroshocker to evaluate nearshore fish populations in rivers. *The Progressive Fish-Culturist* 42(2): 93-95.

Monitoring interactions between spring and river fish communities: The effects of spring runs on temperature and fish movements**Park:** OZAR

Summary: The Current and Jacks Fork river watersheds are heavily influenced by large springs. In 2007, the Heartland I&M Network initiated a long-term fish monitoring program of the springs. There is a lack of knowledge, however, on the interaction between these large springs and the rivers. Springs have consistent temperature throughout the year, while the river temperature fluctuates seasonally. Thus, water flowing from the springs cools the river in summer and warms the river in winter, affecting water temperature for long distances downstream. This change in temperature at the confluence of spring runs and the mainstem will affect the fish assemblages present. Further study on fish movement and the timing of movement in and out of the springs, numbers and types of fish species that utilize these springs in different seasons, and the effect of water temperature of springs on river fish communities is needed. To determine the magnitude and distance of this temperature change, temperature loggers can be placed in the spring run, above the confluence of the spring and the mainstem, and at locations downstream of the confluence. Fish can be sampled at these same locations using similar techniques to the current I&M protocol for OZAR. Fish movement and timing can be documented through tagging specific species of concern (i.e., game fish or highly migratory fish) via radio telemetry or mark/recapture techniques. Samples should be taken seasonally, but particularly in summer and winter when the effects of the spring on river temperatures are likely to reverse.

Expected outcomes: This inventory will increase our knowledge of fish communities inhabiting the spring runs of OZAR. The results of this study will also determine the magnitude of the effects of these large springs on temperature and fish communities in the mainstem, and how fish use of these springs and areas below spring runs may differ with season.

Contact: Dodd

Mapping of vegetation in springs and rivers**Park:** OZAR, BUFF

Summary: Native aquatic vegetation plays an important role in aquatic ecosystems as both a food source and habitat for organisms. Introduction of non-native invasive species can dramatically alter a lotic system, and concern with transport of aquatic invasive plants via boats, trailers, and fishing gear has increased in recent years. Both OZAR and BUFF receive heavy recreational use by fishermen using boats or canoes. The Heartland I & M Network is currently monitoring aquatic vegetation (as well as physical habitat and biotic communities) in six large springs at OZAR. However, there has been no mapping of the aquatic vegetation in these spring runs or the rivers in the park. In addition, mapping of aquatic vegetation at BUFF is lacking. Identification and collection of locations (GPS) and dimensions of vegetation stands along the river or spring run could be completed during summer months.

Expected outcomes: This project will supplement the current monitoring of spring runs at OZAR and provide needed data on invasive aquatic vegetation in these parks. Mapping aquatic vegetation will provide good baseline data for monitoring trends in density and location of native and invasive vegetation.

Contact: Bowles/Dodd